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CONFERENCE REPORT

Report on the 4th International Conference on Autonomous Infrastructures, Management, and Security (AIMS 2010) and the International Summer School on Network and Service Management (ISSNSM 2010)

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Abstract This article contains the report on AIMS 2010, which was held June 23–25, 2010 at the Department of Informatics (IFI), University of Zürich, Switzerland and which was driven by the theme "Mechanisms for Autonomous Management of Networks and Services". Furthermore, the report also synopsizes ISSNSM 2010, which was run June 21–23, 2010 at the same location and which offered a practical summer school on selected topics in network and service management.

Keywords Network management · Service management · Autonomous infrastructures · Security

1 Introduction

The 4th International Conference on Autonomous Infrastructures, Management, and Security (AIMS 2010) and the 4th International Summer School on Network and Service Management (ISSNSM'08) were held in a collocated manner for 2.5 days each at the University of Zurich, Switzerland, on June 21—25, 2010 [1, 2]. The entire technical and local organization had been performed by the Communication

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Systems Group (CSG) of the Department of Informatics (IFI) at the University of Zurich, which was supported technically and financially by the European Sixth Framework Program (FP6) Network of Excellence (NoE) for the "Management of Internet Technologies and Complex Services" (EMANICS) [3]. Further support was provided by the FP7 Specific Targeted REsearch Project (STREP) SmoothIT (Simple Economic Management Approaches of Overlay Traffic in Heterogeneous Internet Topologies) [4]. Additionally, AIMS 2010 was co-sponsored by IFIP TC6.6 [5] and the CSG@IFI [6].

This report summarizes the core concepts followed in AIMS and ISSNMS for the fourth time. It shows an approach with good benefits for students and interested researchers in a field with highly interrelated theoretical *and* practical aspects. This report briefly discusses the technical programs of AIMS and ISSNSM. The 5th AIMS and ISSNSM are already planned for 2011 and potentially interested people will be welcome to check for details, following the new links to be established originating from [1].

2 Concept and Approach

The 2.5-day AIMS conference [1] was planned and run as a single-track event. Preceded by the summer school, the AIMS program itself included regular paper sessions, a key note address, and tutorial Ph.D. workshop sessions. This approach allows for an exchange of ideas in research between Ph.D. students and senior researchers. The theme of AIMS 2010 was "Mechanisms for Autonomous Management Networks and Services" and focused on autonomous management and mechanisms in support of decentralized management approaches.

Summer schools hold a quite important position in teaching and education, especially with regard to students and researchers who are interested in getting attached to a new field of expertise in a limited period of time. EMANICS determined that there is a stringent demand to educate Ph.D. students in the area of network and service management across affiliations and country borders. After the 1st ISSNSM hosted by the Jacobs University Bremen, Germany, the 2nd ISSNSM hosted by the University of Zürich, Switzerland, already, and the 3rd ISSNSM hosted by University of Federal Armed Forces Munich, Germany, the 4th ISSNSM returned to Zürich. It was clearly focused on extended practical parts; i.e., typical classroom teaching took place for about one third of the time and in the other two thirds of the time practical lab courses with experiments addressed the respective topic's key aspects.

Thus, the full understanding of theoretical concepts *and* practical approaches, tools, and systems has proven to be a highly successful summer school concept since the accompanying instructor-supervised lab courses deepened the knowledge of the topic extremely well. Unlike a typical one-way lecture or book reading the work in practice together with the systems at hand provided real-world examples of the application of knowledge.

3 AIMS Keynote and Tutorial

Historically, AIMS key notes address real life, industrial problem areas as well as less-academic, business-driven constraints. In that context the key note presentation on "Facing Complexity in Systems Management" was given by Metin Feridun, IBM Research Zurich, Switzerland. While Metin has worked in management-related topics for years, this talk outlined that emerging technologies, such as cloud computing, the use, proliferation, and mobility of powerful end-user devices, are essential. In addition, the migration of applications to the Internet is creating exciting challenges to the management of IT (Information Technology) infrastructures in general. Those include, amongst others, massive scale and distribution of IT resources, the expectation of high availability of Internet-based services, and a heterogeneity of resources, all of which increase the complexity that system administrators encounter. Therefore, optimized approaches are needed for service management as well as configuration management in an ever increasing software and system environment in which, e.g., "old" components need to be continued in reliable operation while "new" ones have to be seamlessly integrated at the same time.

The AIMS tradition to offer fully integrated tutorials was continued. Luca Deri, from ntop, Italy, an expert in accounting management, spoke about "Large-scale Flow Monitoring Through Open Source Software". He argued that large and high-speed networks produce a large number of flows that need to be collected and analyzed. This tutorial provided insights into an appropriate solution for the situation wherein collectors are unable to keep up with the flow export rate and also have severe speed limitations when creating reports. Due to recent innovation in databases, combined with existing open-source software applications, a very well suited flow collection and exploration of large-scale flows has become feasible. This is extended by the Web 2.0 technology to enable network administrators to analyze data collected in real-time and to explore them interactively by means of a Web browser.

4 AIMS Technical Paper Program and Topics

The technical paper sessions included topics in the areas of "P2P-based Systems", "Autonomous Management", and "Management Mechanisms". These technical sessions were complemented by a "Short Paper Session" on various interesting topics of emerging, but still on-going work. All appeared in the proceedings [7].

Based on 27 submissions the three technical paper sessions were filled with 9 selected papers. Additionally, 5 short papers were also selected. Each full paper was presented in a 20 min time slot followed by 10 min for questions and discussions. Such timing proved necessary and sufficient in fully considering the content of each paper.

To be able to value the best paper within the AIMS conferences, a best paper award committee was established and included Marinos Charalambides (UCL, UK), Ramin Sadre (University of Twente, The Netherlands), and the two TPC co-chairs

of AIMS, namely Filip De Turck (Ghent University, Belgium) and Burkhard Stiller (University of Zürich, Switzerland). Based on the best formal review results three papers were closely analyzed and their presentations were taken into consideration. Finally, two papers received and split the Best Paper Award which was financially sponsored by IFIP TC6.6. One of the winning papers was "Mining NetFlow Records for Critical Network Activities" by Shaonan Wang, Radu State, Mohamed Ourdane, Thomas Engel. The other was "Implementation of a Stream-based IP Flow Record Query Language" by Kaloyan Kanev, Nikolay Melnikov, Jürgen Schönwälder. While the former paper investigates an intelligent data-mining technique for discovering relevant information in huge network monitoring datasets, the latter paper describes in detail an undertaken implementation of a flow query language which overcomes existing limitations in complexity and performance. For their scientific and technical detail, refer to the full papers at [7].

5 AIMS Ph.D. Workshop

Such a Ph.D. workshop approach and format is quite unique and was integrated into the AIMS program as in previous years to show that Ph.D. research in its initial stage, or upon finalization, can lead to substantive discussions, views, and suggestions. Eleven presentations of Ph.D. projects were selected out of 22 submitted proposals. In 10 min each, selected projects presented their core ideas, the solution approach, and the challenges faced. The Ph.D. workshop papers were organized into two sessions on "Overlays and Non-conventional Network Infrastructures" and "Security, Network Monitoring, and Analysis".

Questions posed in these two sessions covered aspects like "What is the relevance of your problem identified?", "In which way do you see an application of your work in tomorrow's IT systems?", and "Why should someone apply your expected results in an operational manner?". The discussion of advantages and drawbacks continued during the breaks and did establish new human connections of expertise.

6 Summer School Program and Topics

The 2.5-day summer school [2] selected 3 topics out of a number of proposals collected from within the EMANICS community and beyond. Those 3 topics, summarized below, covered the areas of (1) Wireless Sensor Network Management, (2) Device Management, and (3) Traffic Mining.

6.1 A Practical Introduction to 6LoWPAN: Programming IPv6 Wireless Sensor Networks with Contiki

Today, wireless networks consisting of low powered devices find an increasing number of application areas in fields like vehicular networks, sensor networks, mobile ad-hoc networks, and smart grids. Low power networks are used in different

ways, such as to retrieve sensor data or to manage and to control devices. Hence, the need for interoperability has emerged.

The development of protocols, which are suited for low power embedded devices, is challenging in dimensions of highly limited computing power, low data rates, and energy constraints. Accordingly, the 6LoWPAN standard [8] was developed to address these challenges as it provides a method for low power embedded devices to communicate using IPv6 over IEEE 802.15.4 networks.

Consequently, the aim of this tutorial was to introduce attendees to programming embedded devices. To that aim, virtual machines running the Contiki OS (Operating System) were used for setting up IPv6-enabled wireless sensor networks. Attendees were also introduced to the 6LoWPAN standard. In practical exercises attendees learned the basics of programming with Contiki and were walked through setting up an IPv6 network using real sensor network motes. Attendees gained experience in developing their own custom applications by learning how to send and to receive messages via the UDP protocol over the IPv6 network.

6.2 Embedded Automation Systems and Device Manageability Instrumentation

The operation of network-based IT applications and services in a professional and timely manner has become an increasingly challenging task over the last few years. New challenges embrace, for example, (a) the ongoing virtualization and distributed deployment of business-critical applications and services or (b) an increase in bandwidth requirements, network links, and number of transactions per seconds on those links. This situation is complemented by different operational dimensions of contractual SLA (Service Level Agreement) obligations, legal requirements, industry standards, and by dynamically changing user and application expectations.

Accordingly, this tutorial showed ways in which concepts of self-* and autonomic systems have been finding their way from research and academia into the networking industry, and how manageability and embedded automation capabilities with the network itself have evolved. In particular, the tutorial explained how network elements today differ from what they were a few years ago as they now offer a plethora of embedded functionality in order to measure, to detect, to decide, and to act upon information from within the network.

This tutorial made use of a combination of theory and practical hands-on examples to discuss the capabilities of Embedded Automation Systems. This included a detailed look at implications, benefits, and challenges of using embedded automation. Technology examples used covered Cisco's IOS® embedded manageability instrumentation, such as IP SLA, Embedded Event Manager (EEM), Flexible NetFlow (FNF), Network Based Application Recognition (NBAR) and Embedded Packet Capture (EPC).

6.3 Traffic Mining: Feel the Packets, be the Packets

The IP network introduced a new quality of threat, when real infrastructures, such as telecommunication, electrical, transport and banking systems, were infiltrated by the

virtual world with its standard PC hardware and software. Software became an end in itself and a weapon. Unnecessary high complexity, unstable behavior, and a new kind of criminal activity arose. Thus, the targeted at IT warfare and the ignorance of the administrative management toward technical and human complexity issues had to be settled. Nevertheless, this situation was accepted and promoted regardless of the fact that this was violating the most basic principles of reliable design, testing, and robustness. The general acceptance of product selection solemnly by economic and political factors now demands its toll.

This tutorial addressed reasons for today's calamity and the tutorial motivated the current civil and military research efforts to solve the most urgent problems on a short and long time scale. The tutorial embraced practical insights into the practice of infrastructure troubleshooting and traffic mining with respect to the danger of today's trust in tools instead of decent human knowledge. Attendees were taught the potential of the human brain, mining in IP data streams using KISS (Keep It Small and Simple) tools on selected examples, such as Skype, but also on real world processed datasets in legal agreement with the owner. The positive magic of critical thinking, proper preprocessing, and visually exploring datasets were demonstrated. Besides practical considerations the dark side of traffic mining was also briefly discussed. All what you should not do includes: The application of Churchill's law, the negative magic of statistical spin doctors, an insufficient preprocessing, the balancing heuristics versus facts, "wish you were here" or "get there effect".

7 Experiences and Next Steps

This year's summer school 2010 was attended by 15 people from 7 different countries and from 10 different affiliations. Furthermore, 5 people attending ISSNSMS did not belong to EMANICS, thus, showing that the interest in network and service management runs well beyond the NoE's limits. The majority of attendees came from universities representing Ph.D. students. In addition, the number of registered participants for AIMS was 41. Participants originated from 14 different countries and from which about 50% have neither been EMANICS nor SmoothIT project members.

The goal of highly interactive, open-ended discussions in a relaxed environment were achieved, since interactions between Ph.D. students themselves as well as senior researchers were common place. Even the technical excursion to the Technorama in Winterthur (Swiss Science Center) [9], providing hands-on experiments in the fields of mechanics, magnetism, electricity, perception, math-magics, and water/nature/chaos, followed by a joint dinner attracted almost all attendees!

Due to very positive feedback regarding AIMS, ISSNSM and the accompanying stimulating discussions, the conference and the summer school for 2011 are in the planning phase and will continue as the 5th event with a similar concept as described.

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Author Biographies

Prof. Dr. Burkhard Stiller is a full professor and is chairing the Communication Systems Group CSG, Department of Informatics IFI at the University of Zürich UZH since 2004. He holds a Computer Science Diplom and a Ph.D. degree from the University of Karlsruhe, Germany. During his research locations of the Computer Laboratory, University of Cambridge, UK, the Computer Engineering and Networks Laboratory, ETH Zürich, Switzerland, and the University of Federal Armed Forces, Munich, Germany, his main research interests cover, including current CSG topics, charging and accounting of Internet services, economic management, systems with a fully decentralized control (P2P), telecommunication economics, and biometric management systems. He participates in a number of European, industrial, and Swiss research projects and serves as a technical program committee member as well as chair of several conferences.

Prof. Dr. Filip De Turck is a full-time professor since 2006 and is affiliated with the Department of Information Technology of the Ghent University and the IBBT (Interdisciplinary Institute of Broadband Technology Flanders) in the area of telecommunication and software engineering. He holds a Ph.D. degree in Electronic Engineering from Ghent University. His main research interests include scalable software architectures for telecommunication network and service management, performance evaluation and design of new telecommunication and eHealth services. He participates in various research projects with industry and academia on these topics and serves as program committee member of several conferences and workshops in this research area.

Cristian Morariu received his Masters of Science degree from Technical University of Cluj-Napoca, Romania in June 2004. His major at the Faculty of Automation and Computer Science, was performed in Computer Science. While holding an ERASMUS scholarship he developed his Master Thesis at the Swiss Federal Institute of Technology (ETH Zürich), Laboratory of Software Technology. Since September 2004 he is a doctoral student at the University of Zurich, Department of Informatics, Communication Systems Group. His main interests are in the area of IP accounting and distributed architectures for traffic analysis.

Martin Waldburger holds a Master of Science (M.Sc.) degree, which he received in 2004 from the University of Zürich. In the same year, he joined Prof. Dr. Burkhard Stiller's Communication Systems Group (CSG) at the University of Zurich in the position of an assistant and doctoral student. He participated in the European Union project "Access to Knowledge through the Grid in a Mobile World" (Akogrimo) and the "European Union Network of Excellence for the Management of Internet Technologies and Complex Services" (EMANICS). His research work is concerned with technical, legal, and business aspects of electronic service provisioning in multi-domain environments. In particular, he is focusing on research challenges in automated contract formation for value-added electronic services in an international context.